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THE  
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AND THE DIAGNOSIS OF ASTIGMATISM.

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THE collection of the data which are presented in this paper was begun in October, 1891, about one year after I had procured an ophthalmometer and had become familiar with the working of it. My instrument is No. 160, model of 1889, and was manufactured by A. Goubeaux at Paris. So far as I am able to judge, it is as perfect and reliable as any instrument of its kind. For practical use it is placed upon a movable table before a north window, which extends to the ceiling of my office and which is unobstructed by adjacent buildings. The lower part of the window is provided with an opaque curtain, which may be raised or lowered at the will of the observer. The illumination is, therefore, excellent. The method of manipulating the ophthalmometer was that suggested by Dr. Motais,\* and whenever, for one reason or another, the reading was not satisfactory, the manœuvres were repeated until a correct result was obtained. My own error of refraction was annulled by properly adjusted spectacles, which had been fitted to me.

\* *Mémoires d'ophthalmométrie*, Paris, 1890, pp. 25 *et seq.*

by an eminent oculist while the accommodation was paralyzed by atropine. Repeated attempts to detect some error in these glasses have always failed. The conditions, then, in the observing eye may be regarded as satisfactory.

The cases reported are not all that I have examined with the ophthalmometer, or in which I have used atropine to facilitate the diagnosis of errors of refraction since last October. Neither are they selected cases. They are simply those cases which have come under my observation on days when pressure of work was not too great to afford me sufficient time for taking more than ordinary pains with these examinations.

Long before this investigation was undertaken I had become convinced that the readings of the ophthalmometer in my hands could not be relied upon to indicate the number of the correcting lens. This had been the experience of others more familiar with the instrument than I. The object in view in all attempts to relieve symptoms by glasses being to increase the acuteness of vision, or to relieve the ciliary muscle of a harmful burden without diminishing the sharpness of sight, the fact that the lenses suggested by the ophthalmometer very frequently diminished the patient's acuteness of vision was early noted in the trials. For one reason or another, therefore, the ophthalmometric findings could not, without a knowledge of the variation incident to the instrument, be regarded as a safe guide to the diagnosis of astigmatism. If the error in the ophthalmometric readings were a constant quantity, the instrument would become almost indispensable to ophthalmologists. If the variation were irregular and at times excessive, the value of the ophthalmometer as a diagnostic agent would proportionately depreciate. In order to determine the variation incident to my instrument in my hands, I began the study of the cases herein reported.

Now, when all the conditions necessary to perfect ophthalmometry are fulfilled—in other words, when the patient is in correct position and his eyes are steady, when the light is the best possible, when the observer's eyes are steady and their refractive error perfectly corrected, when the lenses of the instrument are perfectly clean and the cross-hairs exactly at the focus of the ocular—it is still a delicate matter to positively assure one's self that the corneal images of the reflectors are exactly in apposition and that the dark transverse line of one reflector joins the dark transverse line of the other to make one continuous straight line. I would not deny that it is possible to make a correct observation in the first position. I do mean to suggest that an error as great as 0·25 D., one way or the other, may be and is, no doubt, commonly made in the initial adjustment of the ophthalmometer. From this it follows that in the reading of fractions of a dioptrē errors are commonly made. In the appended reports I wish to be understood. I do not pretend to accurately bisect the image of one half of one step of the reflector; and when the reading is, for example, 0·25 or 0·75, I wish to convey the idea that the overlapping of the reflectors was, as nearly as I could estimate, one quarter or three quarters of the step.

In practice, an error of 0·25 D. in a cylindrical glass is important. Undoubtedly there are astigmatic people to whom it makes very little difference whether their glasses are accurately fitted or not. But there is another class of patients to whom life is almost a burden if their cylindrical lenses are not adjusted to a quarter of a dioptrē. The relief afforded by such weak cylinders is sometimes almost incredible; but the instances of it are so numerous as no longer to require reiteration. Whatever the explanation may be, the fact still remains. And so long as a one-quarter D. glass has a beneficent influence upon asthenopia and

headache, by all means should the refractive error be measured as closely as that, whether hypnotism, mesmerism, or any other ism or faith cure is, or is not, the basis of the relief afforded thereby.

The axis of the astigmatism is determined by the position of the transverse dark lines of the reflectors; and in both the first and the second positions those lines should meet to form a continuous straight line. That it is not an easy matter in some cases to determine when they form a continuous straight line, every one who has had any experience with the instrument can testify. Hence an error of five or more degrees may not infrequently be made in this regard. An error of five degrees may not be very important, still it is sufficient to introduce an element of uncertainty into the investigation.

The cases reported are subdivided into three classes: Table A, cases in which atropine was used; Table B, cases of cataract extraction (with an iridectomy); Table C, cases in which atropine was not used. In each instance the greatest possible caution was observed to eliminate every error from the conditions and the results of the observation, both in the ophthalmometric examination and in that by the trial lenses, test letters, and dial. The data given are, therefore, the best obtainable in these patients.

In each instance the number of instillations of atropine drops is stated. The practice was to order a four-grain solution of sulphate of atropine, one drop of which to be instilled into each eye, night and morning, sometimes at noon also. The state of the accommodation was determined by the patient's ability to read common print and by the facility with which the subjective examination was conducted. Whenever any suspicion arose respecting the thoroughness of the action of the mydriatic, more of the drug was ordered. It may be objected that this is a crude

method of measuring the effect of atropine. Nevertheless, it is the method commonly practiced, and therefore it suits the purposes of this inquiry. Of course an ophthalmoscopic examination was made in each case. No record of the results is given, because I do not pretend to measure refraction to less than 0.50 D. with the ophthalmoscope.

The grand total of eighty-eight comparative examinations may be regarded as quite sufficient for the basis of a generalization. And the one which comes most forcibly to my thought is that, in my hands at least, the variation incident to the ophthalmometer in the diagnosis of astigmatism is not a constant quantity. *Indeed, it would be very surprising if this were not so.* The reasons for this may now be given :

1. The anterior surface of the cornea is not spherical ; it is ellipsoidal ; hence the measurement of its curvature by the Javal-Schiötz instrument is only approximately correct.
2. The ophthalmometer does not deal with that portion of the cornea through which the visual line passes, but with an annular segment about 1 mm. distant from the visual line. It must be assumed that the curvature at the visual line is the same as that of the surface measured. This may or may not be the case. Hence, another source of error in ophthalmometry.
3. The ophthalmometer does not inform us respecting the posterior surface of the cornea. If the posterior surface of the cornea be not parallel to the anterior surface, that condition will influence the refraction of light. There is no reason to suppose that the surfaces of the cornea are strictly parallel to each other. And hence another source of error in ophthalmometry.
4. The ophthalmometer does not measure lenticular astigmatism, and this may be an important error.

5. In the adjustment of the ophthalmometer and in the estimation of the amount of overlapping of the reflectors an error of  $\pm 0.25$  D. is not easy to eliminate. Hence another source of error in practical ophthalmometry.

In conclusion, permit me to add that I consider the ophthalmometer a useful adjunct to other methods of diagnosis. It serves to point the way to a probable diagnosis of astigmatism, and, in my experience, it is especially useful when the astigmatism is of high degree. More than this should not be claimed for it. It gives no information respecting the kind of astigmatism, whether it be simple or compound or mixed. The retinoscope and the ophthalmoscope, in the hands of ordinary men, do not, in the minor errors of refraction, give sufficiently definite information to supplement the ophthalmometer in this essential particular. We are, therefore, finally compelled to clinch or correct our diagnosis by resorting to the subjective method. The chief obstacle to a correct diagnosis of an error of refraction is the contraction of the ciliary muscle. Remove that obstacle and the problem is reduced to its lowest terms. Such problems may be most certainly reduced to their lowest terms by means of atropine.

*March 28, 1891.*

TABLE A.—*Cases in which Atropine was used.*

No.	Name.	Vision.	Javal's ophthalmometer.	REFRACTION.	Difference.
1	Mrs N. O. Wallace, June 6, 1891; before atropine.	R. $6/5$ —. L. $6/10$ .	.....	R. c. + 0·25, ax. $75^\circ$ , V. = $6/6$ . L. c. + 0·25, ax. $110^\circ$ , V. = $6/10$ . Advised atropine; did not prescribe lenses.	R. 1·00. L. 0·75.
	Nov. 28, 1891, atropine 4 times; A. M. P. M. . . . .	R. $5/6$ . L. $5/6$ .	R. $\pm 1$ , ax. $165^\circ$ or $75^\circ$ . R. $\pm 0·75$ , ax. $5^\circ$ , $10^\circ$ , $100^\circ$ , or $105^\circ$ . R. $\pm 0·50$ , ax. $150^\circ$ or $60^\circ$ . L. $\pm 0·50$ , ax. $25^\circ$ or $100^\circ$ .	R. s. + 4·50, V. = $6/6$ . L. s. + 4·50, V. = $6/6$ . Patient persistently rejected cylindrical lenses. <i>Ditto.</i>	R. 1·00. L. 0·75.
2	Mrs. B. W. Wilcox, July 17, 1891; before atropine.	R. $6/10$ . L. $6/10$ .	.....	R. c. + 0·25, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·25, ax. $90^\circ$ , V. = $6/6$ .	R. 0·50. L. 0·50.
	Nov. 30, 1891, atropine 4 times.	R. $6/20$ —. L. $6/30$ .	R. $\pm 0·50$ , ax. $180^\circ$ . L. $\pm 0·50$ , ax. $95^\circ$ .	R. s. + 1·50, V. = $6/6$ —. L. s. + 1·50, V. = $6/6$ —.	R. 0·50. L. 0·50. This patient rejected cylindrical lenses.
3	Mr. R. C. Mills, Dec. 2, 1891; before atropine.	R. $6/5$ . L. $6/5$ .	R. $\pm 0·50$ , ax. $180^\circ$ . L. $\pm 0·50$ , ax. $180^\circ$ .	R. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0. L. 0.
	Dec. 3, 1891, atropine 3 times.	R. $6/15$ . L. $6/15$ .	R. $\pm 0·50$ > 1, ax. $180^\circ$ . L. $\pm 0·50$ > 1, ax. $180^\circ$ .	R. s. + 0·75—c. + 0·50, ax. $90^\circ$ , V. = $6/6$ . L. s. + 1·00—c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
4	Mr. H. S. Drey, Dec. 2, 1891; before atropine.	R. $6/6$ —. L. $6/6$ —.	R. $\pm 1·00$ , ax. $180^\circ$ . L. $\pm 1·00$ , ax. $180^\circ$ .	R. s. + 0·50—c. + 0·75, ax. $90^\circ$ , V. = $6/6$ . L. s. + 0·50—c. + 0·75, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
	Dec. 5, 1891; before atropine 6 times.	R. $6/15$ . L. $6/15$ .	R. $\pm 0·50$ , ax. $180^\circ$ . L. $\pm 0·50$ , ax. $180^\circ$ .	R. s. + 0·50—c. + 0·75, ax. $90^\circ$ , V. = $6/6$ . L. s. + 0·50—c. + 0·75, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
5	Miss G. L. Griswold, Dec. 10, 1891; before atropine 6 times.	R. $6/16$ . L. $6/16$ .	R. $\pm 0·75$ , ax. $180^\circ$ . L. $\pm 0·75$ , ax. $180^\circ$ .	R. s. + 1·25—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
	Miss M. E. Hathorn, Oct. 30, 1891; after atropine.	R. $6/30$ . L. $6/30$ .	.....	..... R. s. + 1·25—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
6	P. M. . . . .	R. $6/20$ . L. $6/20$ .	.....	..... R. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ . R. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
	Dec. 15, 1891; without atropine.	R. $6/5$ —. L. $6/5$ —.	.....	..... R. s. + 0·25—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25; R. 0·50. L. 0·25.
7	Nellie Prindle, 10 yrs. old; Dec. 22, 1891; atropine 3 times.	R. $6/30$ . L. $6/30$ .	.....	..... R. s. + 1·00—c. + 1·50, ax. $60^\circ$ , V. = $6/10$ —. L. s. + 1·00—c. + 1·50, ax. $90^\circ$ , V. = $6/10$ —.	R. 0·25. L. 0·25.
	Dec. 23d, atropine 5 times.	.....	R. $\pm 2$ , ax. $165^\circ$ , $170^\circ$ , $80^\circ$ , or $82^\circ$ .	R. s. + 2·50—c. + 1, ax. $90^\circ$ , V. = $6/6$ . L. $\pm 2$ , ax. $180^\circ$ or $90^\circ$ .	R. 1·00. Axes do not correspond; L. 0·50.
8	Mr. E. S. Hawes, July 19, 1890; before atropine.	R. $6/5$ . L. $6/5$ .	.....	..... R. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
	July 21, 1890; after atropine.	R. $6/15$ . L. $6/15$ .	.....	..... R. c. + 0·25—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·25—c. + 0·25, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
9	Mr. M. S. Allen, Sept. 22, 1891; before atropine.	R. $6/10$ . L. $6/10$ .	.....	..... R. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ . L. c. + 0·50, ax. $90^\circ$ , V. = $6/6$ .	R. 0·25. L. 0·25.
	Dec. 28, 1891.	.....	R. $\pm 0·75$ , ax. $180^\circ$ . R. $\pm 0·75$ , ax. $180^\circ$ .	..... R. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/5$ —. L. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/5$ —.	R. 0. L. 0.
10	After atropine 3 times; Dec. 29, 1891.	.....	..... R. $\pm 0·75$ , ax. $180^\circ$ . R. $\pm 0·75$ , ax. $180^\circ$ .	..... R. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/5$ —. L. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/5$ —.	R. 0·50. L. 0·50.
	Miss C. L. Bicknell; before atropine, Dec. 31, 1891.	R. $6/6$ . L. $6/6$ .	.....	..... R. $\pm 0·75$ , ax. $180^\circ$ . R. $\pm 0·75$ , ax. $180^\circ$ .	R. 0·25. L. 0·25.
11	Jan. 1, 1892; atropine 3 times.	R. $6/10$ . L. $6/10$ .	.....	..... R. $\pm 0·75$ , ax. $175^\circ$ or $5^\circ$ . R. $\pm 0·75$ , ax. $175^\circ$ or $5^\circ$ .	R. 0·50. R. axes do not correspond; L. 1·00.
	Mr. C. A. Brown; before atropine, Jan. 4, 1892.	R. $6/5$ . L. $6/10$ .	.....	..... R. c. + 0·50, ax. $90^\circ$ , V. = $6/5$ .	R. 0·50.
12	After atropine, Jan. 5, 1892.	.....	.....	..... R. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/5$ —. L. s. + 0·75—c. + 0·25, ax. $90^\circ$ , V. = $6/5$ —.	R. 0·50. L. 0·50.
13	Mr. F. E. Copeland; before atropine, Feb. 29, 1892.	R. $6/6$ . L. $6/9$ .	.....	..... R. $\pm 1$ , ax. $165^\circ$ . L. $\pm 1$ , ax. $180^\circ$ .	R. 0·50. L. 0·50.
14	Master Arnold, aged 9 yrs.; Feb. 12, 1892, atropine 6 times.	R. $6/12$ . L. $6/12$ .	.....	..... R. $\pm 1·50$ , ax. $180^\circ$ . L. $\pm 1·50$ , ax. $180^\circ$ .	R. 0·50. L. 0·50.
	Miss M. H. Bowditch; before atropine, Feb. 3, 1892.	R. $6/30$ . L. $6/6$ .	.....	..... R. $\pm 1$ , ax. $180^\circ$ . L. $\pm 1$ , ax. $180^\circ$ .	R. 0·50. L. 1·00.
15	Miss C. A. Skinner; before atropine, March 7, 1892; before atropine twice.	R. $6/6$ . L. $6/6$ .	.....	..... R. $\pm 1$ , ax. $165^\circ$ . L. $\pm 1$ , ax. $180^\circ$ .	R. 0·50. L. 0·50.
	March 9th, atropine twice.	R. $6/6$ . L. $6/6$ .	.....	..... R. $\pm 1$ , ax. $160^\circ$ or $90^\circ$ . L. $\pm 1$ , ax. $180^\circ$ .	R. 0·50. L. 0·50.
16	Miss M. Hodges, March 12, 1892; before atropine twice.	R. $6/6$ . L. $6/12$ .	.....	..... R. $\pm 1$ , ax. $160^\circ$ or $90^\circ$ . L. $\pm 1·25$ , ax. $180^\circ$ or $90^\circ$ .	R. 0·50. L. 0·50.
	March 14, 1892, atropine twice.	R. $6/6$ . L. $6/30$ .	.....	..... R. $\pm 1$ , ax. $165^\circ$ . L. $\pm 0·50$ , ax. $180^\circ$ .	R. 0·50. L. 0·50.
17	Miss E. D. Smith, March 16, 1892; atropine twice.	R. $2\frac{1}{2}$ . L. $3/50$ .	.....	..... R. $\pm 1$ , ax. $160^\circ$ or $90^\circ$ . L. $\pm 1·25$ , ax. $165^\circ$ .	R. 0·25. L. 0·25.
18	Miss A. Hall, March 18, 1892; atropine 3 times.	R. $5/10$ . L. $3/50$ .	.....	..... R. $\pm 0·50$ , ax. $170^\circ$ or $100^\circ$ . L. $\pm 0·50$ , ax. $165^\circ$ or $105^\circ$ .	R. 0·25. L. 0.
19	Miss A. Hall, March 18, 1892; atropine 3 times.	R. $2\frac{1}{2}$ . L. $3/50$ .	.....	..... R. $\pm 0·50$ , ax. $170^\circ$ or $100^\circ$ . L. $\pm 0·50$ , ax. $165^\circ$ or $105^\circ$ .	R. 0·25. L. 0·25.

TABLE A (Continued).

No.	Name.	Vision.	Javal's ophthalmometer.		REFRACTION.	Difference.
			REFRACTION.			
20	Ada Tower, aged 11 yrs.; before atropine, Jan. 7, 1892.	R. $6/15$ , ax. $180^\circ$ . L. $6/50$ .	R. $\pm 0.75$ , ax. $180^\circ$ . L. $\pm 0.75$ , ax. $165^\circ$ .	R. s. — $0.75$ , V. $= 6/6$ . L. s. — $1.50$ $\supset$ c. — $0.25$ , ax. $90^\circ$ , V. $= 6/6$ .	R. s. — $0.75$ , ax. $180^\circ$ , V. $= 6/5$ . L. c. — $0.50$ , ax. $180^\circ$ , V. $= 6/6$ .	R. 0.75. L. 0.50. Axes do not correspond.
21	Mrs. J. C. Levengood; before atropine, Feb. 18, 1892.	R. $6/12$ . L. $6/30$ .	R. $\pm 1.25$ , ax. $180^\circ$ or $90^\circ$ . L. $\pm 1$ , ax. $165^\circ$ or $75^\circ$ .	R. c. — $0.50$ , ax. $180^\circ$ , V. $= 6/6$ . L. c. — $0.50$ , ax. $180^\circ$ , s. — $1$ , V. $= 6/5$ .	R. c. — $0.50$ , ax. $180^\circ$ , V. $= 6/6$ . L. c. — $0.50$ , ax. $180^\circ$ , s. — $1$ , V. $= 6/5$ .	R. 0.75. L. 0.50. Axes do not correspond.
22	Lucy Brown, aged 12 yrs.; atropine.	R. $4/60$ . L. $4/60$ .	R. $\pm 1$ , ax. $180^\circ$ . L. $\pm 1$ , ax. $180^\circ$ .	R. s. — $0.50$ $\supset$ c. — $0.75$ , ax. $180^\circ$ , V. $= 6/6$ . L. s. — $0.25$ $\supset$ c. — $1$ , ax. $180^\circ$ , V. $= 6/6$ .	R. s. — $0.50$ $\supset$ c. — $1$ , ax. $180^\circ$ , V. $= 6/6$ . L. s. — $0.25$ $\supset$ c. — $1$ , ax. $180^\circ$ , V. $= 6/6$ .	R. 0.25. L. 0. Axes do not correspond.

*Summary.*—Total cases, 22; total number of eyes, 44; total number of comparative examinations, 63.

Ophthalmometer and trial lenses agreed. . . . . 12, or 19% Ophthalmometer greater than trial lenses by 0.25 D. . . . . 15

" " 0.25 D. . . . . 2

" " 0.50 D. . . . . 25, or 39%

" " 0.50 D. . . . . 1

" " 0.75 D. . . . . 3, or 0.4%

" " 1.00 D. . . . . 5, or 0.8%

— 63

If we assume that the difference of 0.25 D. was due to imperfect contact of the reflectors in the first position, we have  $12 + 15 + 2$ , or 29 examples of agreement between the two methods of diagnosis, or 46 per cent. of the total number.

TABLE B.—*Cases of Cataract Extraction.*

No.	Name.	Vision.	Javal's ophthalmometer.		REFRACTION.	Difference.
			REFRACTION.			
1	Mr. W. Felch; operation with iridectomy, October, 1891.	L. $\pm 5$ , ax. $180^\circ$ ; against rule.	L. s. + $10$ $\supset$ c. + 3, ax. $180^\circ$ , V. $= 6/15$ .	L. 2.00.	To obtain this result I have excluded— Case 1, because trial lenses showed no astigmatism. " 2, " " 6, left eye, because of ophthalmometer showed no astigmatism.	
2	Mr. F. A. Brown, Jan. 4, 1892.	L. $\pm 3$ , ax. $10^\circ$ ; against rule.	L. s. + $13$ $\supset$ c. + 1, ax. $10^\circ$ , V. $= 6/9$ .	L. 2.00.	Reads Jaeger No. 1 with s. + $17$ $\supset$ c. + 3, ax. $180^\circ$ . Media perfectly clear.	
3	Miss Nellie Button, 16 yrs.; Oct. 23, 1891.	L. $\pm 3$ , ax. $170^\circ$ .	L. s. + $1$ with s. + $16$ $\supset$ c. + 1, ax. $10$ .	L. 0.	Reads Jaeger No. 1 with s. + $17$ $\supset$ c. + 3, ax. $180^\circ$ . Media perfectly clear.	

*Comment.*—These cases are reported because the media were perfectly clear. In both the ophthalmometer indicated 2 D. more astigmatism than the trial lenses did. In both the vision by the subjective examination was much superior to that obtained when the cylinder indicated by the ophthalmometer was tried. Both patients read Jaeger No. 1 rapidly with the glasses indicated above. According to my experience, the ophthalmometer always exaggerates the astigmatism in cases of cataract extraction by one or more dioptres.

TABLE C.—*Cases in which Atropine was not used.*

No.	Name.	Vision.	Javal's ophthalmometer.		REFRACTION.	Difference.
			REFRACTION.			
1	Mr. C. R. Palmer, Jan. 3, 1892.	R. $6/30$ . L. $6/30$ .	R. $\pm 1$ , ax. $180^\circ$ . L. $\pm 1$ , ax. $180^\circ$ .	R. s. — $2$ $\supset$ c. — $0.75$ , ax. $90^\circ$ , V. $= 6/6$ . L. s. — $2$ $\supset$ c. — $0.75$ , ax. $90^\circ$ , V. $= 6/6$ .	R. c. — $2.25$ , ax. $180^\circ$ , V. $= 6/9$ . L. c. — $2.25$ , ax. $180^\circ$ , V. $= 6/9$ .	R. 0.25. L. 0.25.
2	Mr. F. A. Brown, Jan. 4, 1892.	R. $6/15$ . L. $6/15$ .	R. $\pm 2$ , ax. $175^\circ$ . L. $\pm 3$ , ax. $170^\circ$ .	R. c. — $1$ , ax. $180^\circ$ , V. $= 6/6$ . L. c. — $1.50$ , ax. $180^\circ$ , c. + 0.50, ax. $90^\circ$ , V. $= 6/6$ .	R. c. — $4$ , ax. $165^\circ$ , c. s. — $5.50$ , V. $= 6/9$ . L. c. — $4$ , ax. $180^\circ$ , c. s. — $5.50$ , V. $= 6/20$ .	R. 1.00. L. 1.00.
3	Jan. 5th.	R. $6/12$ . L. $6/15$ .	R. $\pm 1.50$ , ax. $175^\circ$ or $100^\circ$ . L. $\pm 2.50$ , ax. $175^\circ$ .	R. c. — $1$ , ax. $180^\circ$ , V. $= 6/5$ . L. c. — $2$ , ax. $180^\circ$ , c. s. + $0.50$ , V. $= 6/5$ .	R. c. — $1.50$ , ax. $80^\circ$ , V. $= 6/12$ . L. c. + $3.50$ , ax. $70^\circ$ , V. $= 6/9$ .	R. 0.50. L. 0.50. The axes did not correspond in either examination.
4	Miss McIlvain, Feb. 5, 1892.	R. $6/15$ —. L. $6/20$ +.	R. $\pm 2.75$ , ax. $180^\circ$ . R. $\pm 3$ , ax. $172^\circ$ .	R. c. — $2.25$ , ax. $175$ , V. $= 6/9$ . L. c. — $3$ , ax. $180^\circ$ , c. s. + $2.50$ , V. $= 6/6$ .	R. c. — $2.25$ , ax. $180^\circ$ , V. $= 6/9$ . L. c. — $3$ , ax. $180^\circ$ , c. s. + $2.50$ , V. $= 6/6$ .	R. 0.25. L. 0.25.
5	Miss Nellie Button, 16 yrs.; Oct. 23, 1891.	R. $6/60$ . L. $6/9$ .	R. $\pm 5$ , ax. $165^\circ$ . R. $\pm 2$ , ax. $170^\circ$ .	R. c. — $4$ , ax. $165^\circ$ , c. s. — $5.50$ , V. $= 6/9$ . L. c. — $4$ , ax. $180^\circ$ , c. s. — $5.50$ , V. $= 6/20$ .	R. c. — $4$ , ax. $165^\circ$ , c. s. — $5.50$ , V. $= 6/9$ . L. c. — $4$ , ax. $180^\circ$ , c. s. — $5.50$ , V. $= 6/20$ .	R. 1.00. L. 0.50.
6	Miss Bessie Bickford, Dec. 31, 1891.	R. $6/15$ . L. $6/20$ .	R. $\pm 2$ , ax. $10^\circ$ . L. $\pm 2$ , ax. $150^\circ$ .	R. c. — $1.50$ , ax. $170^\circ$ , V. $= 6/12$ . L. c. — $2$ , ax. $60^\circ$ , c. s. + $2.50$ , V. $= 6/6$ .	R. c. — $1.50$ , ax. $170^\circ$ , V. $= 6/12$ . L. c. — $2$ , ax. $130^\circ$ , c. s. + $2$ , V. $= 6/12$ .	R. 0.50. L. 1.00.
7	Mrs. C. E. Bush, Feb. 26, 1892.	R. $6/60$ . L. $6/30$ .	R. $\pm 1.50$ , ax. $155^\circ$ . L. $\pm 3$ , ax. $25^\circ$ .	R. s. + $3.50$ $\supset$ c. — $1.50$ , ax. $155^\circ$ , V. $= 6/9$ . L. c. + $3$ , ax. $25^\circ$ , V. $= 6/12$ .	R. s. + $3.50$ $\supset$ c. — $1.50$ , ax. $155^\circ$ , V. $= 6/9$ . L. c. + $3$ , ax. $25^\circ$ , V. $= 6/12$ .	R. 0. L. 0.
8	March 5th.	R. $6/30$ . L. $6/30$ .	R. $\pm 1.50$ , ax. $155^\circ$ . L. $\pm 3$ , ax. $25$ .	R. s. + $3.50$ $\supset$ c. — $1.50$ , ax. $155^\circ$ , V. $= 6/9$ . L. c. + $3$ , ax. $25$ , V. $= 6/12$ .	R. s. + $3.50$ $\supset$ c. — $1.50$ , ax. $155^\circ$ , V. $= 6/9$ . L. c. + $3$ , ax. $25$ , V. $= 6/12$ .	R. 0. L. 0.
9	March 14th.	R. $6/60$ . L. $6/60$ .	R. $\pm 1.50$ , ax. $155^\circ$ . L. $\pm 3$ , ax. $25$ .	R. s. + $4.50$ $\supset$ c. — $3$ , ax. $25^\circ$ , V. $= 6/12$ . L. c. + $4.50$ $\supset$ c. — $3$ , ax. $25^\circ$ , V. $= 6/12$ .	R. s. + $4.50$ $\supset$ c. — $3$ , ax. $25^\circ$ , V. $= 6/12$ . L. c. + $4.50$ $\supset$ c. — $3$ , ax. $25^\circ$ , V. $= 6/12$ .	R. 0. L. 0.

*Summary.*—Total cases, 7, or 14 eyes; total number of comparative examinations, 21.

Ophthalmometer and trial lenses agreed. . . . . 5, or 23%

Ophthalmometer greater than trial lenses by 0.25 D. . . . . 3, or 14%

" " " " 9, or 42%

" " " " 4, or 19%







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